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Quantifying catchment and community-based stream monitoring in Aotearoa New Zealand

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Quantifying catchment and community-based stream monitoring in Aotearoa New Zealand

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Prepared for Our Land and Water National Science Challenge

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Contents

1. Introduction and background

Regional and unitary authorities (regional councils) carry out state of the environment (SOE) river and lake water quality and ecological monitoring across Aotearoa New Zealand. The data from this monitoring enable current state and long-term trend analyses for up to 20 years or more for some waterbodies. The data is collected robustly following the National Environmental Monitoring Standards (NEMS), which have been in place since 2013.[1]

In addition to regional council data, many catchment and community groups across Aotearoa New Zealand also monitor the health of their local waterways and lakes. Many of these groups have been collecting data for decades, while others have started more recently (e.g. NZ Water Citizens 2024).

However, despite these collective efforts, recent research has shown that regional monitoring programmes do not sample enough sites to provide an accurate reflection of freshwater ecosystem health across the country (Parliamentary Commissioner for the Environment 2019; McDowell et al. 2024). In particular, detecting water quality improvements can take between 5 and 200 years (Puckett 2004; Meals et al. 2010; Hamilton 2012; Wilcock et al. 2013), a lengthy process requiring significant resources that must be covered by regional councils. Making use of catchment and community-based monitoring (CBM) data, alongside routine SOE monitoring, could assist regional programmes if the data collected is suitable and accessible.

1.1 Giving community-based monitoring data meaning

A national quality assurance framework for CBM has been established to support the collection of robust stream monitoring data that are of a known quality, which is important for third-party users (Milne et al. 2023). Increasingly, groups are well organised, and many are collecting laboratory-based water quality data at fine spatial scales relative to the regional SOE monitoring. Many of these groups have also initiated these monitoring programmes, which are driven by their passion for understanding and improving the health of local waterbodies. The time and money spent on these monitoring efforts are significant, and therefore it is appropriate to invest effort in understanding and identifying the potential applicability of their data to inform freshwater management. A growing number of groups are now sharing their data, and work is already underway to examine how data can be shared efficiently, effectively and appropriately (e.g. Doehring et al. 2022; Wai Connection 2024). However, unlike the structured management of council data, there is no systematic approach to recording the details of community-based monitoring; for example, there is a lack of information regarding the locations of the CBM group sites, the period of time the sites have been monitored, the indicators that are being monitored, and the methods that are used to collect the data.

[1] https://www.lawa.org.nz/

A better understanding of existing community-based freshwater monitoring networks will:

1. help quantify the spatial and temporal extent of CBM data and offer insights into how these data might contribute to regional and national applications such as modelling and environmental reporting
2. provide greater recognition of CBM monitoring efforts, which will give CBM groups a window to realise the potential wider value of their efforts beyond the local catchment scale.

This report documents a small pilot project that aimed to quantify CBM efforts in Aotearoa New Zealand. The project is aligned with Wai Connection,[2] a national programme that aims to empower catchment and community groups by providing knowledge, tools and expert support to help identify freshwater issues in their local catchment area. This pilot project will also inform a more detailed national survey of CBM that Wai Connection has planned for the second half of 2024. The remaining sections of this report provide:

1. a summary 'snap-shot' of selected catchment and community group freshwater monitoring from across Aotearoa New Zealand
2. a brief commentary on the potential uses of CBM datasets and their contribution to improving freshwater management and reporting, particularly in comparison to using only regional council SOE data.

[2] https://www.waiconnection.nz/

2. Methods

2.1 Community-based monitoring metadata

'Catchment care' groups were selected based on the researchers' existing knowledge of their activities; the project also tried to capture a geographic spread across the country. For this report, a total of nine community and catchment groups (or catchment collectives) involved in freshwater monitoring were identified (Table 1); however, we recognise that there are many other groups across Aotearoa New Zealand.

Table 1. Catchment groups that provided water quality monitoring metadata for this report.

Region		Catchment group name
North Island	Auckland	Friends of Awa Matakanakana (FOAM)
	Taranaki	Taranaki Catchment Communities, including: • Awatuna / Auroa • Kaupokonui • Mangamingi • Waingongoro
	Wairarapa	Wairarapa Catchment Collective, including: • Whareama Tīnui CCG • Upper Waipoua Kaitiaki Group • Whangaehu Bideford CCG • Wakamoekau CCG • Upper Mangatarere CCG • Wainuioru River Care Group
	Whanganui-Manawatū	Rangitīkei Rivers Catchment Collective (RRCC)
		Manawatū River Catchments Collective (MRCC)
South Island	Nelson	Friends of Maitai
	Tasman	Tasman Bay Guardians
	Canterbury	Ashburton Forks Catchment Group
	Otago	Pomahaka Water Care Group

Each group was asked to provide the following information:

1. period of time (length) of monitoring
2. frequency of monitoring
3. locations within the catchment
4. indicators / variables monitored
5. measurement / testing of the protocols applied
6. other information about the catchment groups and monitoring (e.g. group structure, date group was established).

2.2 Scoping the potential uses of community-based monitoring data in modelling applications

Online meetings were held with three modellers who are experienced in catchment-, regional- and national-based modelling: Dr Ton Snelder (LWP), James Blyth (Collaborations) and Dr Sandy Elliott (NIWA). The intention of the meetings was to explore the potential uses of CBM data in different modelling applications, and the discussions primarily focused on stream monitoring data. Several examples of existing CBM data collection were briefly described so that the modellers understood the scope and extent of the data collection.

3. Results and discussion

3.1 Summary of community-based monitoring metadata

Monitoring metadata collected from four catchment collectives and five catchment or community groups showed variation in the indicators monitored, the length and frequency of the monitoring, and the monitoring protocols applied within groups as well as across groups (Table 2). This variability in metadata is linked to the different monitoring interests and resourcing constraints. Across the groups, there were also common indicators (e.g. all groups monitored at least one form of nutrients, and many monitored visual clarity and *E. coli*) and methods (Table 2).

One catchment / community group had been collecting water quality data since 2014, while three other groups had started sampling in 2017, 2018 or 2019. The final three groups had carried out work throughout 2023.

Five catchment groups / collectives monitored water quality at monthly intervals, three at quarterly intervals, and one group varied between monthly and 6-monthly intervals. All groups within two catchment collectives had water samples analysed in an accredited laboratory, while most other groups used a range of field-based measurement methods, including NIWA's SHMAK and Auckland Council's Wai Care kits. Two groups had also established water quality sensor-based monitoring programmes. Many groups incorporated ecological monitoring, and several had also collected samples for eDNA testing.

Catchment / community group monitoring sites were generally well dispersed across catchments and complemented the regional council SOE monitoring locations (Figure 1; Appendices 1–9). A more detailed summary for each collective, catchment or community group is provided in the Appendices, including maps of the monitoring sites.

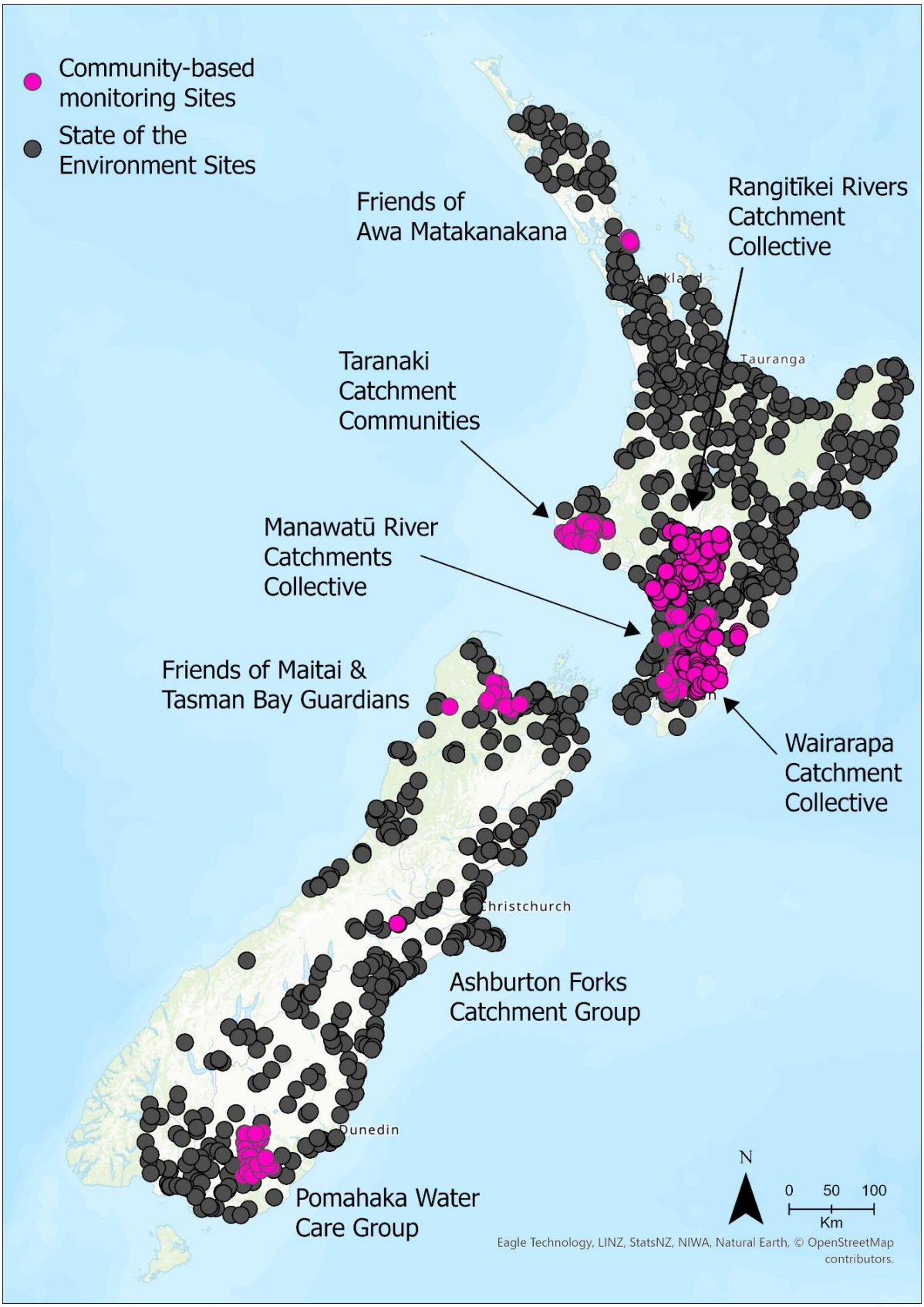

Figure 1. Location and distribution of the community-based monitoring sites summarised for this report in relation to national state of the environment water quality monitoring sites.

Table 2. Summary of freshwater monitoring activities carried out by the selected catchment collectives and catchment groups across Aotearoa New Zealand. The catchment collectives comprise multiple catchment groups, and the groups started monitoring at different times. More details are provided in the appendices.

Region	Group name	Current no. of monitoring sites	Monitoring start date	Frequency of monitoring	Type of monitoring
Auckland	Friends of Awa Matakanakana (FOAM)	11 (1 saline)	2017	Quarterly (water quality and macroinvertebrates) + high frequency turbidity / sediment sensor sites	Wai Care self-test kit and *in situ* turbidity / sediment sensor
Taranaki	Taranaki Catchment Communities	46	January 2023	Monthly	Predominantly water quality – lab-tested
Whanganui-Manawatū	Rangitīkei Rivers Catchment Collective (RRCC)	109	2017	Monthly	Water quality – lab-tested; macroinvertebrates sampled once
	Manawatū River Catchments Collective (MRCC)	69	December 2019	Monthly	
Wairarapa	Wairarapa Catchment Collective	43	2017	Quarterly	Varies by group; some are water quality lab-tested and others are SHMAK field-based
Nelson	Friends of Maitai	2	2014	Monthly	Predominantly SHMAK field-based
Tasman	Tasman Bay Guardians	39	March 2023	Varies between monthly and six-monthly	SHMAK field-based
Canterbury	Ashburton Forks Catchment Group (part of the Mid Canterbury Catchment Collective)	~40	August 2023	Monthly	Nitrate sensor (used in discrete mode in a mini-laboratory set-up)
Otago	Pomahaka Water Care	9	2018	Quarterly	Predominantly water quality lab-testing; some are SHMAK field-based, including macroinvertebrates

3.2 Potential uses of community-based monitoring data in modelling applications

All modellers agreed that CBM data could potentially be useful in a number of modelling applications. The greatest value was identified for spatial statistical models, as the CBM data could infill gaps in space (i.e. increased spatial resolution) by including smaller streams that are not often routinely monitored in regional council SOE monitoring programmes. The most obvious model applications were those used to estimate current state of water quality or ecological variables that are regionally or nationally based on measured values (e.g. total nitrogen concentrations; Figure 2).

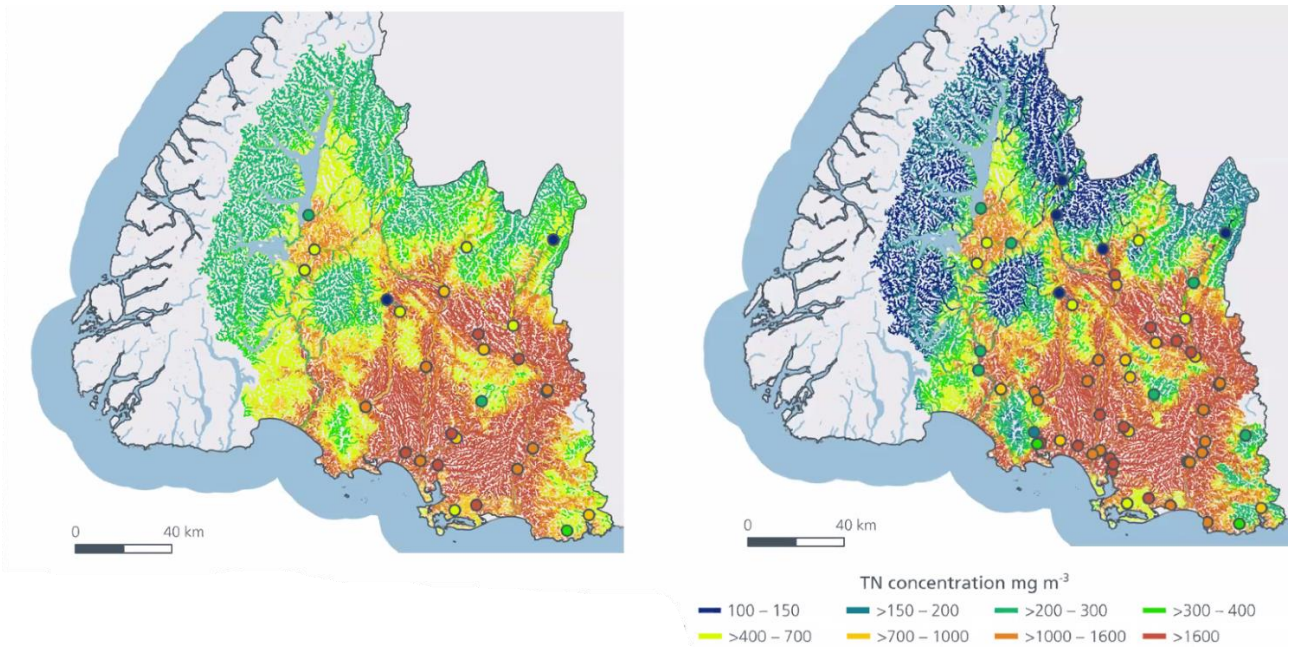

Figure 2. Example illustrating how using data from a greater number of monitoring sites and from across a wider geographical area (right) could improve predictions of total nitrogen concentrations in unmonitored reaches of rivers and streams across the Southland Region (Snelder 2021; Parliamentary Commissioner for the Environment 2024)

The use of CBM data for many modelling applications was limited, including deterministic models that are calibrated to contaminant loads, unless the CBM groups were collecting stream flow information – or this information could be reliably estimated from nearby council flow stations or correlations with similar catchments with flow gauges.

Another potential limitation is the availability of reference sites, and many CBM groups may not have considered the value of a reference site. However, it was also acknowledged that some CBM groups

may have datasets for new reference sites that could help overcome the current lack of reference sites nationally.

The biggest challenges for modellers are identifying the existence of particular datasets and obtaining access to data that is in a useful format. Access to organised data is critical – and the data needs to be of suitable quality. The modellers appreciated that initiatives such as the national CBM quality assurance framework and Wai Connection's proposed national data web portal could increase confidence in and potential access to CBM data. These programmes are particularly important because, in their experience, the modellers had seldom seen CBM groups identify a clear monitoring purpose. Without a clear purpose, there is a risk that the datasets may not be useful, and groups may lack the expertise to optimise the use of their data.

It was generally acknowledged that the models are not perfect, and several are categorised with a high degree of uncertainty. To help improve models, most CBM data could potentially be useful for model verification exercises, even if the data are derived from more basic nutrient self-test kits (e.g. the NIWA SHMAK and Auckland Council's Wai Care kits) that only provide concentrations within a coarse range (low resolution), rather than an absolute measurement value. However, lab-based CBM data of a known quality would likely be even more suitable for model calibration.

Finally, a recent report from the Parliamentary Commissioner of the Environment reinforced that modelling is an important and necessary tool to support freshwater management (Parliamentary Commissioner for the Environment 2024). In Aotearoa New Zealand, models are needed because it is very difficult to produce sufficient monitoring data in time and space to inform best practice decision-making. The report also noted that as models are an extension of data, any shortcomings with the data are carried over into the models (Parliamentary Commissioner for the Environment 2024). This reinforces the potential for CBM datasets to improve several modelling applications. However, this value can only be realised if CBM groups are willing to make their data (including associated metadata) available.

4. Conclusions and recommendations

This preliminary project to quantify freshwater CBM efforts in Aotearoa New Zealand has identified that a wide range of monitoring is being carried out across the county. The sample of community and catchment groups reviewed for this study showed that data collection has been undertaken at over 350 sites across nine catchment groups or collectives. In most cases, multiple variables have been monitored at regular intervals, and some groups now have over 5 years of data. A mixture of standard field and lab-based measurement methods have been used, including NIWA SHMAK and Auckland Council's Wai Care kits, and water sample testing in accredited laboratories. Two groups have also established water quality sensor-based monitoring programmes that include a laboratory verification component.

Discussions with three freshwater modellers found that CBM data has strong potential to inform spatial statistical models used in catchment-, regional- and national-scale modelling and reporting applications. Data that are of high quality could also be used to verify modelling predictions and be applied in model calibration exercises. Flow data are required for most other modelling activities. Overall, the utility of CBM data – in work carried out by catchment and community groups as well as potential third parties – requires the collection of data of a known quality that are fit for purpose.

To increase the utility of CBM information in the future, we recommend the following actions:

- Catchment-based monitoring groups should establish a clear monitoring purpose, ideally in collaboration with their regional council, a water quality extension provider (e.g. NZ Landcare Trust, Mountains to Sea Community Trust) or a freshwater specialist. The data also need to be accessible, along with key metadata such as that summarised in this report (e.g. measurement methods). Consistent monitoring over time is key to realising the full potential of CBM data.
- Regional councils, where applicable and possible, should help CBM groups establish their monitoring purpose or questions. Maintaining consistent monitoring sites and methods over time is critical for most monitoring purposes, including the detection of long-term trends, and discussions between regional councils and CBM groups may enable mutual benefits in terms of stream monitoring. For example, catchment groups could monitor sites that had shifted outside the scope of council management, and vice versa.
- A wider and more comprehensive nationwide exercise should be carried out to quantify and register CBM efforts across Aotearoa New Zealand. This project would increase the visibility of CBM efforts nationally, and, where access is granted, provide an opportunity to weave together CBM and regional council data. By combining these data sources, there is potential for a richer understanding of waterbody health and an improved information base to support freshwater management.

5. Acknowledgements

We thank all of the catchment and community groups that contributed information on their monitoring activities, in particular:

1. Philippa Eberlein (Friends of Maitai)
2. Martin Evans (Friends of Awa Matakanakana)
3. Lou Totman, Harriet Gibson and Julie Ireland (Rangitīkei Rivers Catchment Collective)
4. Maddy Glover (Wairarapa Catchment Collective and Mountains to Sea Conservation Trust)
5. Gwyn Jones (Manawatū River Catchment Collective)
6. Will Wright (Mid Canterbury Catchment Collective)
7. Elliot Easton (Tasman Bay Guardians)
8. Paul Turner (Taranaki Catchment Communities)
9. Craig Simpson (Watershed Solutions, Pomahaka Water Care Group)

We also thank our three modellers, Dr Ton Snelder (LWP), James Blyth (Collaborations) and Dr Sandy Elliott (NIWA) for their input into this report.

6. Appendices

Appendix 1. Friends of Maitai

The Friends of Maitai is an urban catchment group dedicated to the Maitai River and its tributaries, including the Brook. This group has existed in various forms since 1977, with its latest iteration established in 2014. Operating within the Nelson Region, the Friends of Maitai actively monitor the health of the Maitai River. Their monitoring efforts are conducted at two sites that are sampled monthly (Figure 3). The first site has been monitored since 2014, though its location was changed in 2016, and the second site has been monitored since 2015.

Table 3. Freshwater monitoring indicators and method details for river health monitoring for the Friends of Maitai group.

Indicator	Method	Notes
Water temperature	Digital thermometer – also loan a YSI ProQuatro meter when available	
Dissolved oxygen concentration (mg/L)	Wai Care – Winkler titration. Also loan a YSI ProQuatro meter when available	
Dissolved oxygen (% sat)	Calculation based on water temperature or measure by YSI ProQuatro meter when available	
Conductivity	SHMAK conductivity meter	
Visual water clarity	SHMAK clarity tube (0–1 m)	
Sediment	Resuspended sediment shuffle index	From National Sediment Assessment Methods (method 5)
pH	pH test strips	
Dissolved reactive P	Hanna® HI-713 phosphate kit	Kit measures phosphate – calculation performed to express as DRP
Nitrate-N	AquaSpex Microtest® test kit (0–4.5 mg/L)	
Ammoniacal-N	Hach test strips	
E. coli	Membrane filtration (NIWA SHMAK – Petrifilm plates)	
Macroinvertebrates	Field-based ID using SHMAK	
Periphyton	Field-based SHMAK cover assessment	
Rubbish	Presence	
Water depth and width		
Upstream and downstream photo		
Stream habitat		
Rainfall		From Tasman District Council site
Flow		

Appendix 2. Tasman Bay Guardians

The Tasman Bay Guardians are a catchment group operating in the Tasman Region, specifically in the Motueka and Moutere Catchments (Figure 3). Their work involves monitoring the following creeks, streams and rivers: Baton, Beukes, Borck, Dove, Ferrer, Field, Riuwaka, Orinoco, Redwood, Roding, Waiwhero, and Woods. The group maintains 39 monitoring sites, with a detailed schedule for data collection: four sites are monitored quarterly, seven bi-annually, 24 monthly, and four twice a year. Their monitoring activities are based around the NIWA's SHMAK kit and include testing for *E. coli* using Petrifilm plates. Monitoring started in the first half of 2023 for 11 river systems, five of which were discontinued at the end of 2023. Two new river systems were added in 2024, bringing the total to eight river systems that are currently being monitored by the group.

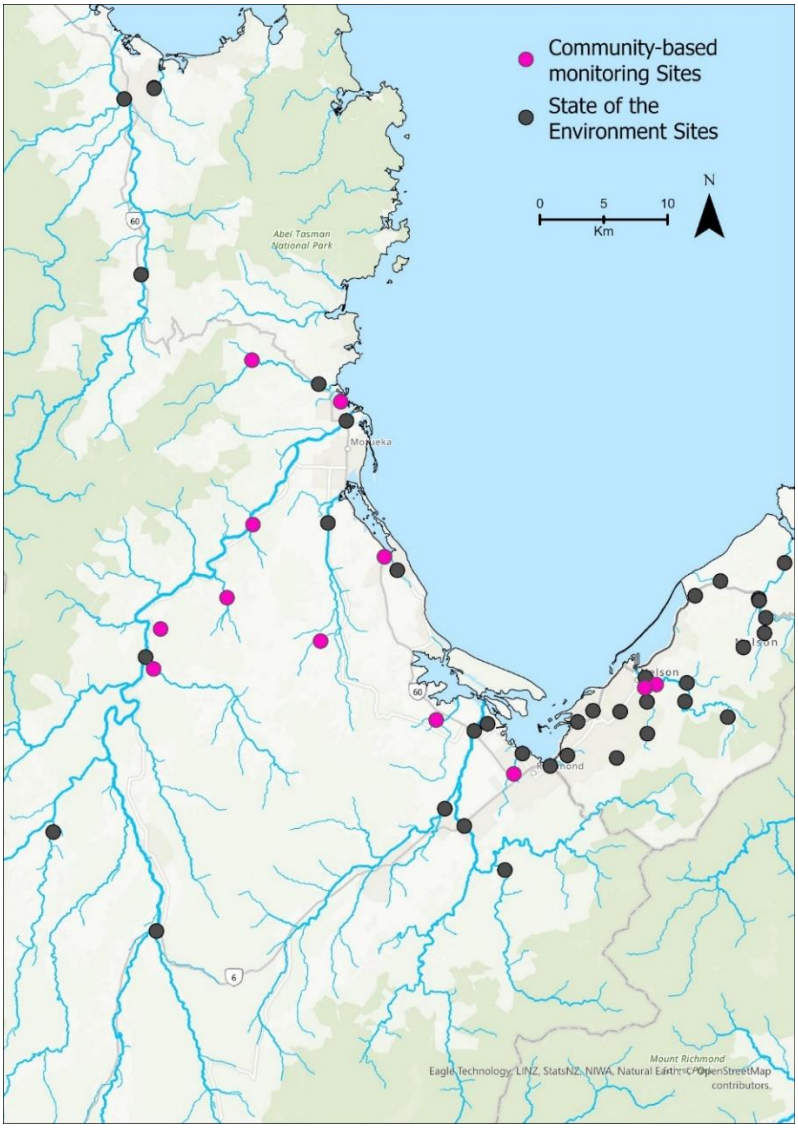

Figure 3. Friends of Maitai (Nelson Region) and Tasman Bay Guardian (Tasman Region) community-based monitoring sites in relation to state of the environment monitoring sites.

Appendix 3. Pomahaka Water Care Group

The Pomahaka Water Care Group was established in 2014 and is a farmer-led initiative focusing on the Pomahaka River catchment in southwest Otago. Between December 2018 and May 2023, the group monitored 31 sites at quarterly intervals, and nine of these sites continue to be monitored. The group has a trained external contractor that collects and sends the water samples to Hill Labs for testing (turbidity, soluble inorganic nutrients and *E. coli*). From 2021 to 2023, the contractor also carried out macroinvertebrate sampling (for Macroinvertebrate Community Index [MCI] calculation) at some sites.

Table 4. Freshwater monitoring indicators and method details for river health monitoring for the Pomahaka Water Care group.

Indicator	Method	Detection Limit
Turbidity	Lab – APHA 2130 B (modified)	0.05 NTU
Ammoniacal-N	Lab – APHA 4500 NH3-H (modified)	0.01 mg/L
Nitrate-N	Lab – calculation	0.002 mg/L
Nitrite-N	Lab – APHA 4500-NO3-I	0.002 mg/L
Nitrate-N + Nitrite-N	Lab – 4500-NO3-I	0.002 mg/L
E. coli	Lab – APHA 9222 G	1 cfu/100 mL
Dissolved reactive P	Lab – APHA 4500-P G	0.004 mg/L

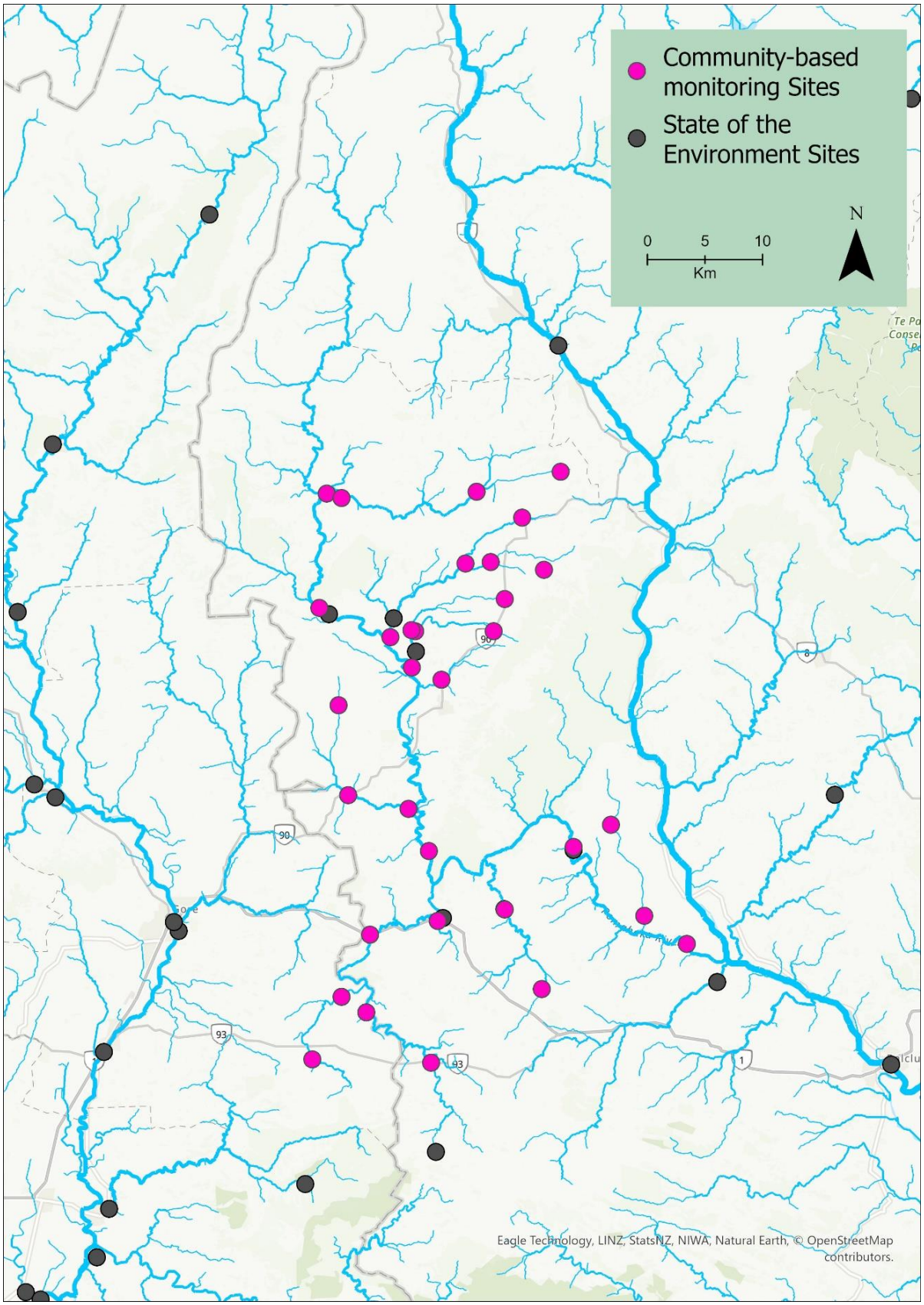

Figure 4. Water monitoring locations for the Pomahaka Water Care Group and state of the environment monitoring in the Otago Region.

Appendix 4. Friends of Awa Matakanakana (FOAM)

The Friends of Awa Matakanakana (FOAM) is a community-based incorporated society established in 2017 that operates in the Matakana and Glen Eden catchments north of Auckland. Monitoring commenced in September 2018 and is currently carried out quarterly at 11 freshwater sites and one saline site. An additional four saline sites that were originally included were dropped in early 2020 after FOAM lost access to a boat for sampling.

Stream monitoring was initially based around Auckland Council's Wai Care kits, but it has since extended to *E. coli* testing and catchment sediment monitoring with the installation of two Phathom S40 dual turbidity / suspended sediment sensors and rainfall gauges. Water samples are periodically collected and tested in an accredited laboratory to verify the sensor's performance. Water samples for eDNA testing have also been collected from some sites.

FOAM has received training from Auckland Council staff (NIWA provided training for *E. coli* testing) and runs training for new volunteers. Procedures and a field form have been developed and various quality checks are carried out (e.g. macroinvertebrates that cannot be identified are photographed for identification by an external expert, and a field meter pre-calibrated by Auckland Council is used for field measurements when available).

In addition to the indicators below, FOAM records a standard set of observations, including the weather, an estimate of flow rate and the presence of kōura and freshwater fish.

Table 5. Freshwater monitoring indicators and method details for river health monitoring for Friends of Awa Matakanakana.

Indicator	Method	Notes
Visual water clarity	SHMAK clarity tube (0–1 m)	Turbidity is estimated from visual clarity using the Wai Care manual
Water temperature	Digital thermometer	Measured along with conductivity using a YSI ProQuatro meter when available from Auckland Council. DO (% saturation) also calculated based on water temperature
Dissolved oxygen (DO) (concentration)	Wai Care – Winkler titration	
Nitrate-N	AquaSpex Microtest® test kit (0–4.5 mg/L)	
Ammoniacal-N	Hach test strips	
Dissolved reactive P	Hanna® HI-713 phosphate kit	Kit measure phosphate – calculation performed to express as DRP
E. coli	Membrane filtration (NIWA SHMAK – Petrifilm plates)	
Macroinvertebrates	Field-based ID using Wai Care (WIMP score)	

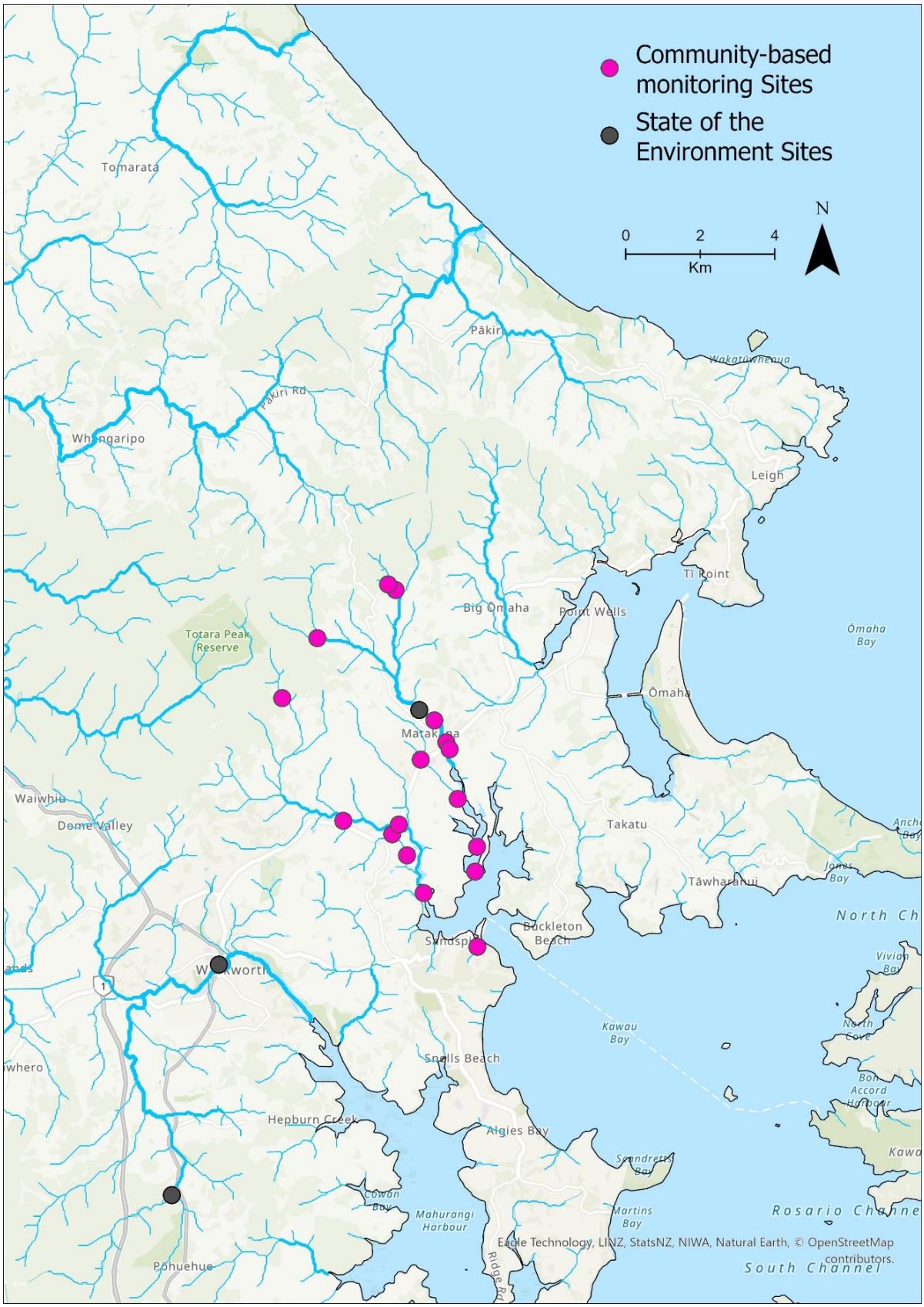

Figure 5. Friends of Awa Matakanakana monitoring sites (including six sites that were only monitored until 2020 and 2022) in relation to state of the environment monitoring sites in the Auckland Region.

Appendix 5. Taranaki Catchment Communities (TCC)

The Taranaki Catchment Communities (TCC) was established in 2020 as a catchment community group collective. It supports 16 catchment groups, including multiple groups involved in stream monitoring (Figure 6).

Figure 6. Sixteen catchment community groups within the Taranaki Catchment Communities.

Taranaki Catchment Communities monitor 46 sites and have been monitoring for 18 months. Water samples are collected monthly and sent to Central Environmental Labs in Palmerston North for analysis. All groups test for nitrate, dissolved inorganic nitrogen (DIN), dissolved reactive phosphorus (DRP), turbidity and *E. coli*.

Additionally, other freshwater monitoring activities include eDNA testing and macroinvertebrate sampling (for Macroinvertebrate Community Index (MCI) calculation). The Awatuna / Auroa groups have conducted eDNA testing and macroinvertebrate sampling twice, and Waingongoro has done so once with Massey University.

Table 6. Freshwater monitoring indicators and method details for river health monitoring for Taranaki Catchment Communities.

Indicator	Method	Detection limit
Turbidity	APHA 2130 B (modified)	0.01 NTU
Dissolved inorganic nitrogen (DIN)	Calculation: from ammoniacal-N, nitrate-N and nitrite-N	0.005 mg/L
Dissolved reactive phosphorus (DRP)	APHA 4500 – P E	0.005 mg/L
Nitrate-N	APHA 4110 B	0.005 mg/L
Nitrite-N	APHA 4110 B	0.005 mg/L
Ammoniacal-N	APHA 4500 NH3-H (modified)	0.005 mg/L
E. coli	APHA 9223 B (Colilert)	1 MPN/100 mL

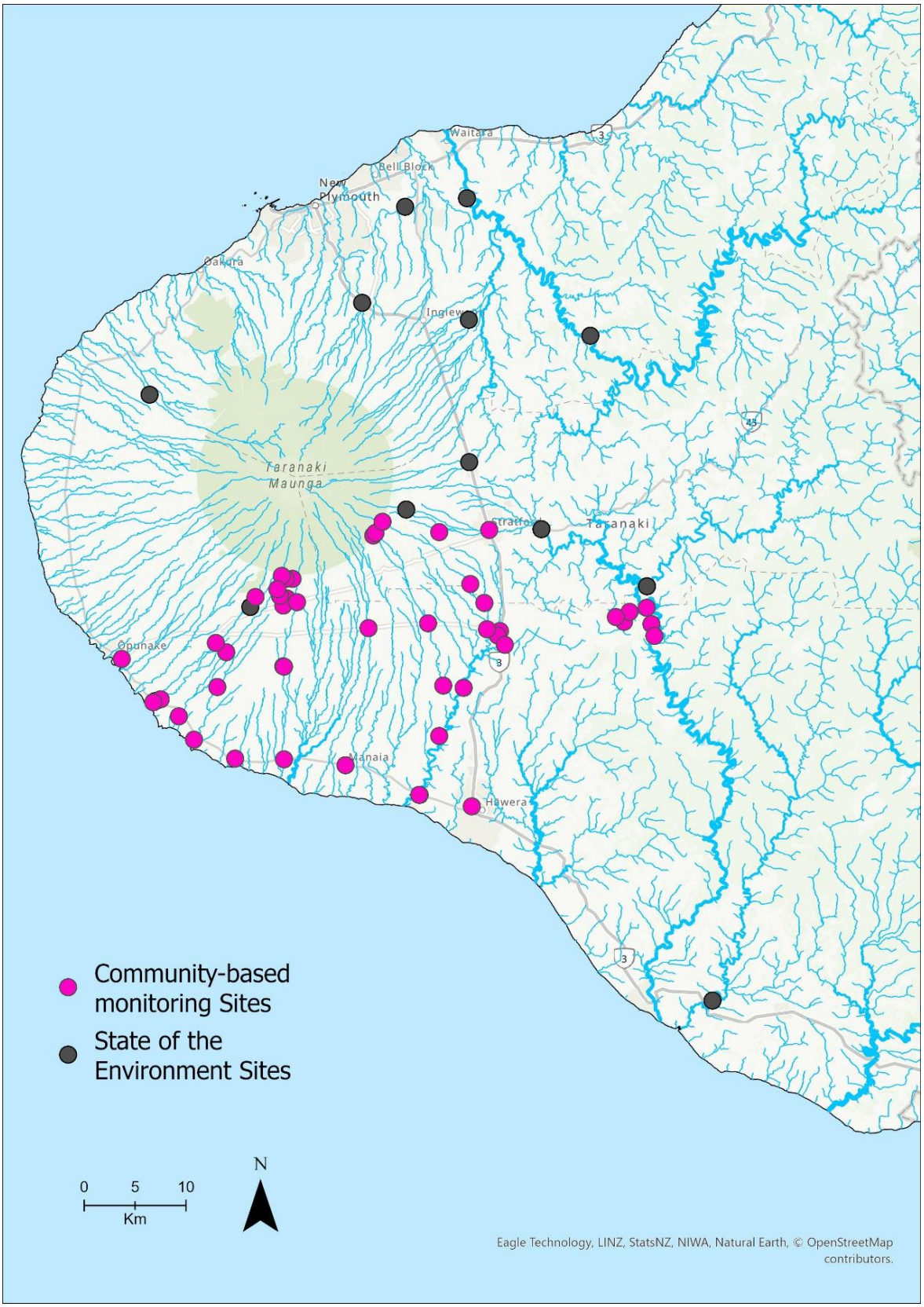

Figure 7. Taranaki Catchment Communities monitor water quality at 46 sites in the southern part of their region. The community groups in the north do not specifically focus on water testing but may focus on technology or well-being (pers. comm. Paul Turner, Taranaki Catchment Communities).

Appendix 6. Rangitīkei Rivers Catchment Collective

The Rangitīkei Rivers Catchment Collective (RRCC) is a farmer-led collective established in 2017 that operates in the Rangitīkei, Whangaehu and Turakina River catchments of the Whanganui-Manawatū (Horizons) region. The collective supports at least 23 sub-catchment groups that are monitoring the same basic suite of water quality variables at monthly intervals. Monitoring start dates vary across the groups, but many now have 3–5 years of monthly water quality data and have had reports prepared on their results.

There is a total of 103 sites sampled monthly, and a large sub-set of these have also been sampled for macroinvertebrates on one occasion.

The NZ Landcare Trust supported the catchment groups with the establishment of monitoring sites and training in water sample collection. Samples are collected by a nominated group member and sent to an accredited laboratory, Central Environmental Labs in Palmerston North, for testing. Macroinvertebrate samples were collected by one of RRCC's coordinators and processed by Cawthron Institute.

Some basic metadata on weather conditions are recorded during water sampling, and the RRCC is looking to extend their observation suite to align with the standard observations included in the national quality assurance CBM framework.

Table 7. Freshwater monitoring indicators and method details for river health monitoring for the Rangitīkei Rivers Catchment Collective.

Indicator	Method	Method detection limit
Turbidity	Lab – APHA 2130 B (modified)	0.01 NTU
Nitrite-N	Lab – APHA 4110 B	0.005 mg/L
Nitrate-N	Lab – APHA 4110 B	0.005 mg/L
Ammoniacal-N	Lab – APHA 4500 NH3-F (modified)	0.005 mg/L
Dissolved inorganic N	Lab – Calculation: Ammoniacal-N + Nitrate-N + Nitrite-N	0.005 mg/L
Dissolved Reactive P	Lab – APHA 4500-P E	0.005 mg/L
E. coli	Lab – APHA 9223 B (Colilert)	1 MPN/100 mL

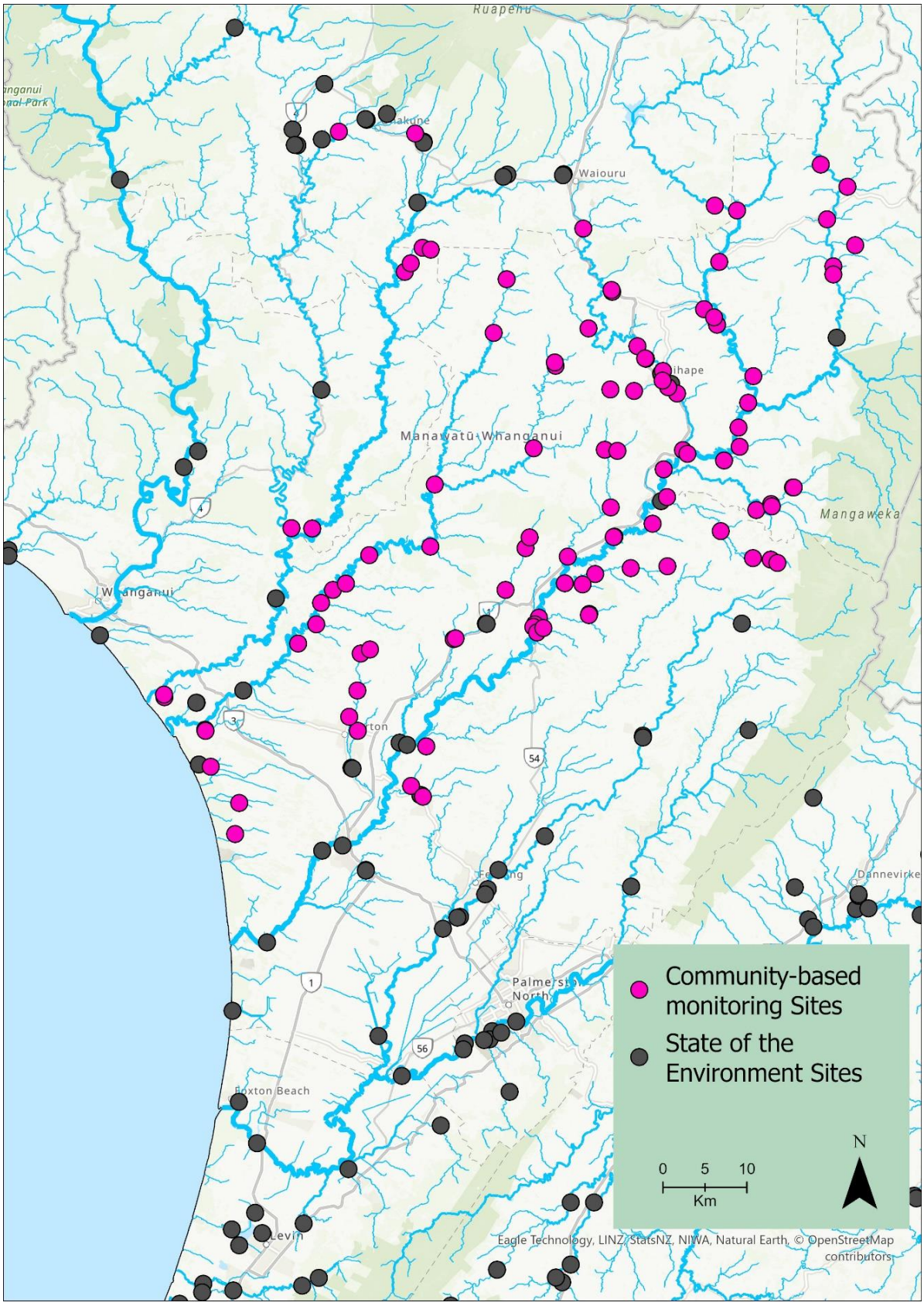

Figure 8. Location of the Rangitīkei Rivers Catchment Collective monitoring sites in relation to state of the environment water quality monitoring sites in the Whanganui-Manawatū Region.

Appendix 7. Wairarapa Catchment Collective

The Wairarapa Catchment Collective was formed in 2023/24 following initial support of catchment groups provided the Wairarapa Pūkaha to Kawakawa Alliance (WP2K). At least six catchment groups (Table 8) are monitoring stream water quality and / or ecology at present covering locations within the Ruamahanga, Whareama and Wainuioru catchments in Wairarapa. Two groups have focused on quarterly water quality monitoring and are submitting their samples to Hill Labs, while four other groups are focused on quarterly streamside-based monitoring methods using the NIWA SHMAK kit. The groups received training in water sample collection and / or use of the NIWA SHMAK kit by trained coordinators and, in some cases, Greater Wellington Regional Council staff.

Table 8. Stream health information about six catchment groups that are part of the Wairarapa Catchment Collective.

Group	Start date	No. of sites	Monitoring variables	Measurement methods	Monitoring frequency
Whareama Tīnui CCG	Oct-2022	10	Turbidity, soluble inorganic and total nutrients, *E. coli*	Hill Labs (see Table 9)	Quarterly (typically)
Upper Waipoua Kaitiaki Group	Dec-2021	6			
Whangaehu Bideford CCG	Nov-2023	10	Visual clarity, conductivity, water temperatures, velocity, nitrate-N, DRP, *E. coli*, macroinvertebrates and physical habitat	SHMAK kit (see Table 9)	Quarterly
Wakamoekau CCG	Apr-2024	6			
Upper Mangatarere CCG	Jan-2024	5			
Wainuioru River Care Group	2017	6			

Table 9. Freshwater monitoring indicators and method details for river health monitoring for the Wairarapa Catchment Collective.

Indicator	Method	Method detection limit
Turbidity	Lab – APHA 2130 B	0.05 NTU
Total Nitrogen	Lab – Calculation: TKN + Nitrate-N + Nitrite-N	0.11 mg/L
Nitrite-N	Lab – 4500-NO3-I	0.002 mg/L
Nitrate-N	Lab – Calculation	0.001 mg/L
Nitrate-N + Nitrite-N	Lab – 4500-NO3-I	0.002 mg/L
Total Kjeldahl N (TKN)	Lab – APHA 4500-Norg D (modified) 4500 NH3 F (modified)	0.1 mg/L
Dissolved Reactive P	Lab – APHA 4500-P G	0.004 mg/L
Total Phosphorus	Lab – APHA 4500-P H	0.002 mg/L
E. coli	Lab – APHA 9222 I (modified, membrane filtration)	1 cfu/100mL
Field-based groups		
Visual water clarity	SHMAK clarity tube (0-1 m)	
Electrical conductivity	NIWA SHMAK field meter	
Water temperature		
Water velocity	Float method (surface velocity)	
Nitrate-N	AquaSpex Microtest® test kit (0-4.5 mg/L)	~0.05 mg/L
Dissolved Reactive P	Hanna® HI-713 phosphate kit	0.03 mg/L (as DRP)
*E. coli**	Petrifilm plate membrane filtration	From 1 cfu/100mL
Physical habitat quality*	SHMAK 8-measure habitat assessment	
Macroinvertebrates	SHMAK kick net method (all/mixed habitat types) with self-identification	

* Not measured by all Wainuioru

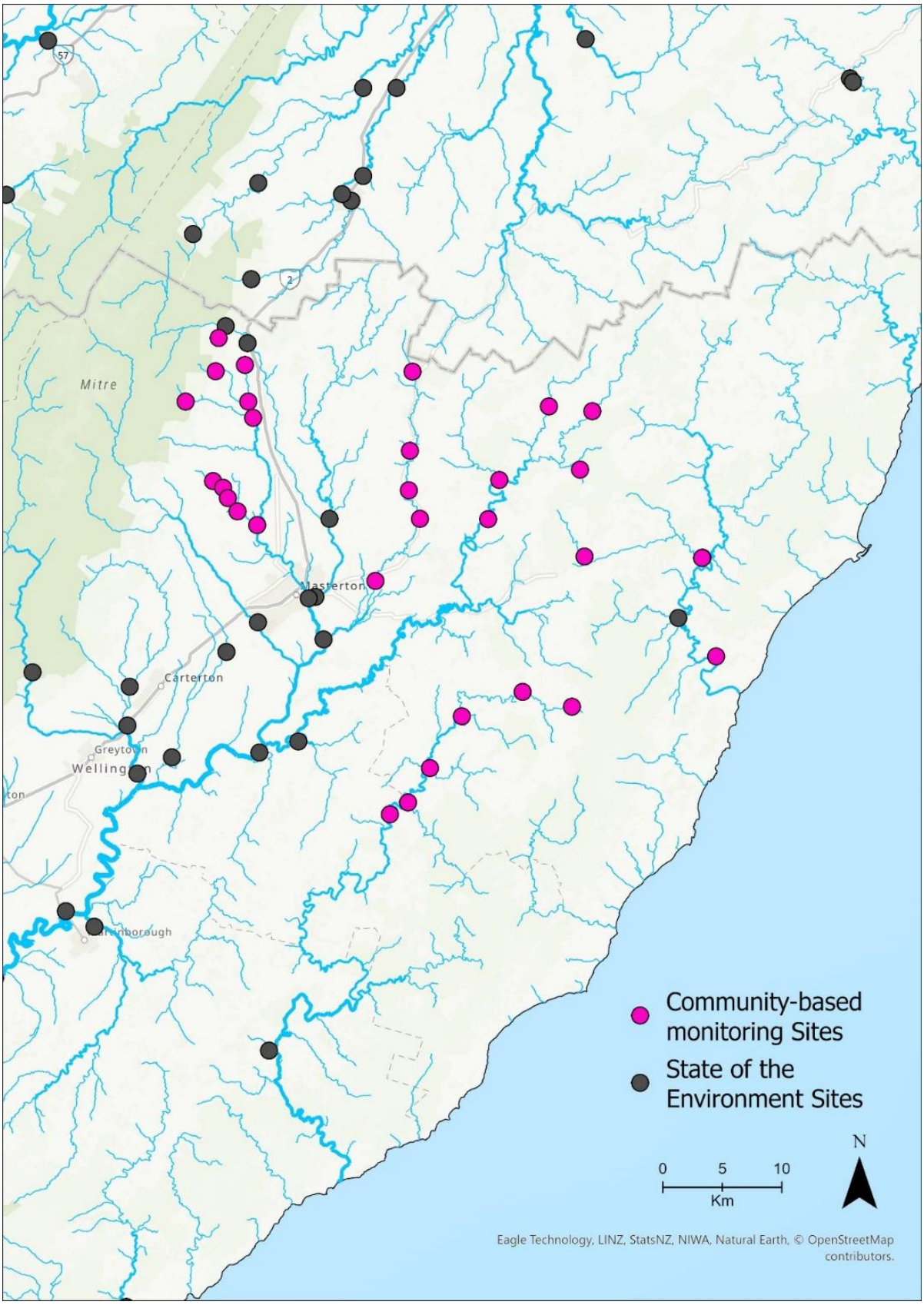

Figure 9. Location of the Wairarapa Catchment Collective monitoring sites in relation to regional council state of the environment water quality monitoring sites in the Wairarapa.

Appendix 8. Manawatū River Catchments Collective

The Manawatū River Catchments Collective (MRCC) is a farmer-led collective established in late 2020 in the Whanganui-Manawatū (Horizons) region. The MRCC currently has 11 active catchment groups involved in monthly collection of water samples. Monitoring start dates vary across the groups, but some now have around 3 years of monthly water quality data. In total, 69 sites are sampled monthly. A sub-set of these sites is shown in the map below (access to some site coordinates were not available at the time of finalising this report). The complete site network is available on a map on the MRCC's website: https://manawatu-river-catchments-collective.co.nz/what-we-do/

Similar to the RRCC, the NZ Landcare Trust supported the MRCC with the establishment of monitoring sites and training of catchment group members in water sample collection. Samples are collected by a nominated group member and sent to an accredited laboratory, Central Environmental Labs in Palmerston North, for testing. Some basic metadata on weather conditions are recorded at the time of water sample collection.

In addition to water quality, macroinvertebrate samples have been collected at 51 sites on one occasion. The samples were processed by Cawthron Institute. Some water sampling for eDNA testing has also been carried out.

Table 10. Freshwater monitoring indicators and method details for river health monitoring for the Manawatū River Catchments Collective.

Indicator	Method	Method detection limit
Turbidity	Lab – APHA 2130 B (modified)	0.01 NTU
Nitrite-N	Lab – APHA 4110 B	0.005 mg/L
Nitrate-N	Lab – APHA 4110 B	0.005 mg/L
Ammoniacal-N	Lab – APHA 4500 NH3-F (modified)	0.005 mg/L
Dissolved inorganic N	Lab – Calculation: Ammoniacal-N + Nitrate-N + Nitrite-N	0.005 mg/L
DRP	Lab – APHA 4500-P E	0.005 mg/L
E. coli	Lab – APHA 9223 B (Colilert)	1 MPN/100 mL

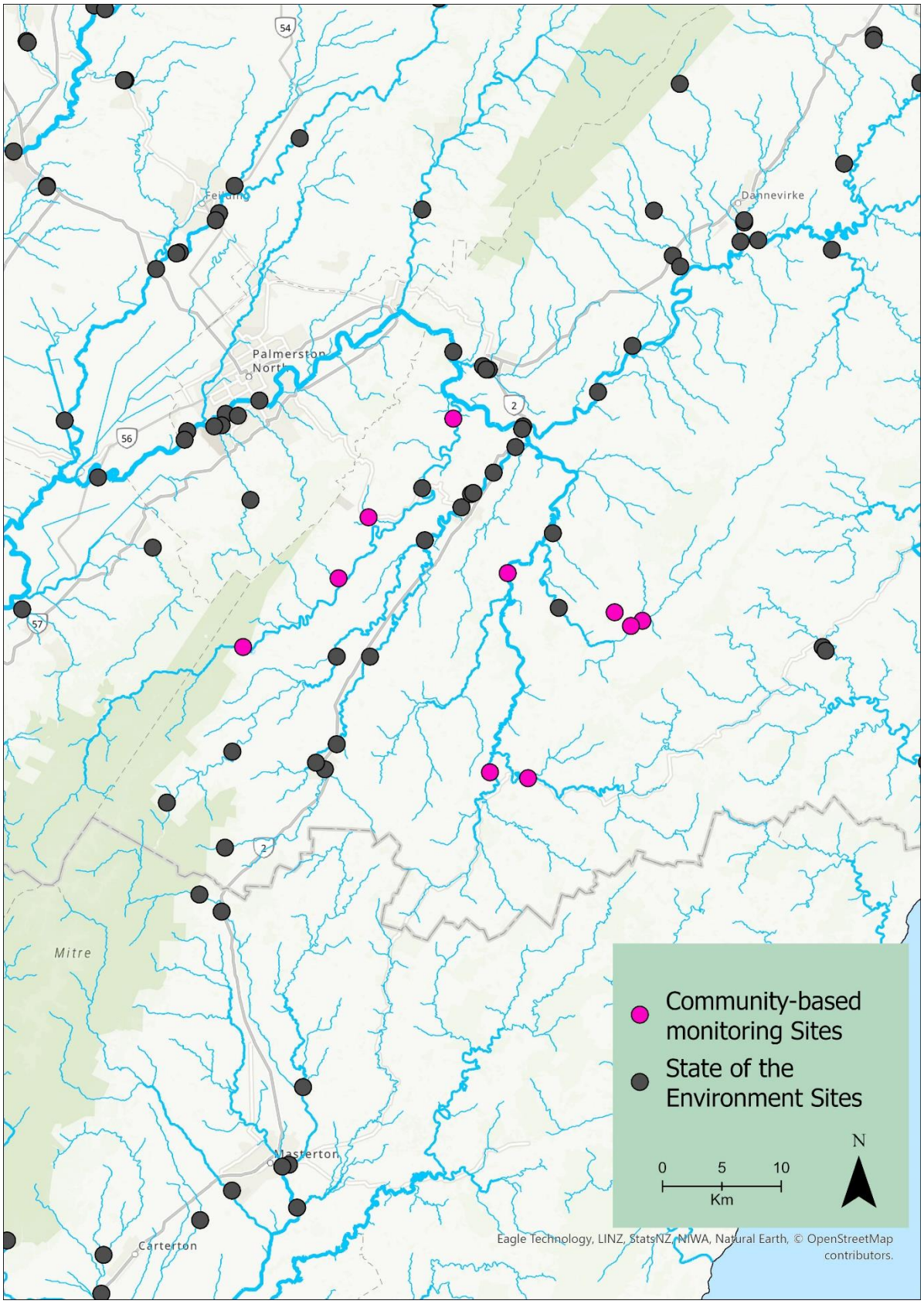

Figure 10. Location of monitoring sites sampled by the Manawatū River Catchments Collective in relation to state of the environment water quality monitoring sites in the Manawatū-Whanganui Region.

Appendix 9. Ashburton Forks Catchment Group

The Ashburton Forks Catchment Group (AFCG) was established in June 2023 and is one of multiple groups that are supported by the Mid Canterbury Catchment Collective (MCCC). Landowners in the AFCG (and other adjacent catchment groups) collect water samples monthly and these are measured for nitrate-nitrogen using a HydroMetrics™ GW50 optical nitrate sensor within a clean office environment. Site numbers have increased since monitoring began in August 2023; currently 40 surface water and shallow groundwater sites are sampled in the Ashburton Forks, Staveley and Alford Forest areas.

The MCCC purchased the nitrate sensor, and an operating procedure has been developed. Only trained catchment coordinators or advisors use the sensor. The sensor operator filters any turbid samples prior to measurement and then sends a sub-set of the monthly water samples to Hill Labs in Christchurch for an independent check on sensor performance. Lab samples are tested using APHA 4500-NO3 I (the NEMS recommended method for nitrate-nitrogen in surface waters). The AFCG has recently commissioned an external review of its water sample collection and measurement procedures to ensure that these procedures support the collection of robust data.

We were unable to retrieve any monitoring site location information for this catchment group in the timeframe needed to complete this report.

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